IDS

(19) Eur päisches Patentamt
European Patent Offic
Offic européen des brevets

(11) Publication number : **0 561 065 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number : **92203679.3**

(22) Date of filing : **27.11.92**

(51) Int. Cl.[5] : **B01D 53/34,** C01B 31/18, A01G 7/02, A01G 9/18

(30) Priority : **27.11.91 NL 9101984**

(43) Date of publication of application : **22.09.93 Bulletin 93/38**

(84) Designated Contracting States : **BE CH DE DK FR GB LI NL SE**

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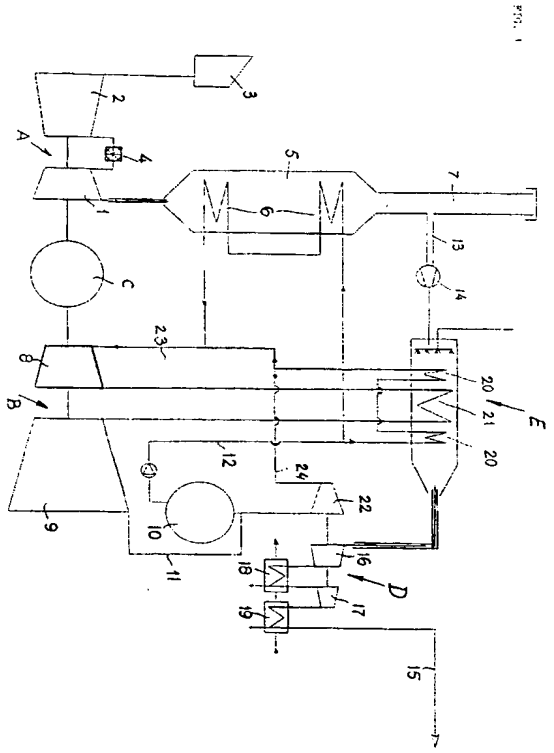
(54) Method and apparatus for producing a gas containing CO2, in particular for CO2-fertilization in the greenhouse horticulture.

(57) The invention relates to a method for producing a gas containing CO_2, in particular for CO_2-fertilization in the horticulture. According to the invention at least a part of the exhaust gasses produced by an installation for central electricity supply is seperated and entered into a distribution system in compressed and cooled state.



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The invention relates to a method for producing a gas containing CO_2, in particular for CO_2-fertilization in the greenhouse horticulture.

In the modern greenhouse horticulture it is generally known to improve the plant growth by application of so-called CO_2-fertilization, in which a gas containing CO_2 is passed into the greenhouses.

The individual market gardens are usually equipped with an own, in general gas-fired combustion device, which is primarily used for providing heat in the greenhouses. The exhaust gasses released during firing the combustion device are currently passed into the greenhouses according common practice to increase the CO_2 content therein. Thus, advantageous use is made of CO_2, which is actually produced free while the combustion device is used as a heat producing device.

However, the demand for heat does not always coincide with the demand for CO_2. In other words, the amount of CO_2 available from the demand for heat usually does not coincide with the demand for CO_2 for an optimum fertilization.

In common practice, the combustion device will often be fired only to provide for the demand for CO_2, while the produced heat will no be used efficiently. The CO_2-fertilization carried out under such circumstances is obviously very uneconomically and according to the present opinions concerning energy consumption in fact not acceptable.

An other way to provide for the demand for CO_2 - independent of a simultaneous demand for heat or not - is the use of pure CO_2, which is delivered in liquid form and can be stored centrally or at the market garden itself. CO_2 in liquid form is however very expensive and is in particular significantly more expensive than CO_2 produced in a heat producing device at the market garden, which is only fired for the purpose of CO_2-fertilization.

To obtain almost pure CO_2-gas from exhaust gasses released in the production of electricity, has a even higher cost level.

The invention now is based on the insight, that large quantities of exhaust gasses produced in the production of electricity nevertheless can be used as CO_2-source in an economically acceptable way, in particular for CO_2-fertilization in the greenhouse horticulture.

Therefore, the method according to the invention is characterized in that at least a part of the exhaust gasses produced by a installation for central electricity supply is seperated and entered into a distribution system in compressed and cooled state.

Comprehensive research and calculations revealed, that in this way, by compressing the exhaust gasses up to for example 10 bar and accordingly keeping the through passage of a network of distribution pipes limited, CO_2-delivery is possible against a costprice, which is attractive for market gardens and which makes it also attractive for these market gardens to obtain also heat required for heating the greenhouses from a common heat distribution system. From an environmental technical point of view, the concentration of the production of heat in a power plant should also have the advantage, that in a power plant provision for "washing clean" the exhaust gasses can be established more easy than at the individual market gardens.

A preferred embodiment of the method according to the invention is characterized in that, prior to the compression, the CO_2 content of the seperated exhaust gasses is enriched by applying these exhaust gasses to an auxiliary combustion device as combustion gas, the exhaust gasses of which are supplied to a compressor.

Despite of the costs for firing and maintaining an auxiliary combustion device, the costprice for the production of CO_2 can nevertheless be lowered, because due to these measures the distribution network may have smaller dimensions and also due to decreased compression costs. In addition, the costs for firing and maintaining the auxiliary combustion device can be compensated, by using at least a portion of the heat produced by the auxiliary combustion device for producing steam, from which at least a portion can be used as power source for the compressor.

Furthermore, the invention relates to a device for carrying out the above described method.

The invention starts from a per se known electricity production plant, comprising a combination of a gas turbine installation provided with a steam generating device, having a exhaust pipe for exhaust gasses, a steam turbine, having a condenser and an electric generator, which steam turbine is fed with steam from the steam generating device, whereby the electricity production plant according to the invention is characterized in that a channel is branched-off from the exhaust pipe of the steam generating device and is leading to a compressor, the output of which is connectable to a distribution network.

In a preferred embodiment, an auxiliary combustion device is accomodated in the branched-off channel to the compressor, whereby the air inlet of the auxiliary combustion device is connected to the exhaust pipe of the steam generating device and the output of exhaust gasses of the auxiliary combustion device is connected to the input of the compressor.

Further features of the invention will be explained below in connection with the drawing of an exemplified embodiment of the invention.

The drawing shows a diagram of a modern electricity production plant, in principle arranged for the production of electric energy (by a generator) and heat (by means of a condenser) and which is, according to the invention, adapted for delivering of gas containing CO_2.

The illustrated plant comprises an usual combin-

ation of a gas turbine installation A, a steam turbine B and an electrical generator C.

The gas turbine installation A comprises the gas turbine 1, the air compressor 2, having an air inlet 3, the combustion chamber 4, which for example is fired with natural gas, and the so called steam generating device 5, having heat exchanger bundles 6 and an exhaust pipe 7 for exhaust gasses.

The steam turbine B comprises a high pressure part 8 and a low pressure part 9, the output of which is connected to a condenser 10 by means of a pipe 11. The steam turbine B is fed with steam, which is generated by passing the condensation water leaving the condenser 10 through pipe 12, through the heat exchanger bundle 6 in the steam generating device 5.

Thusfar, the plant is of a usual embodiment.

According to the invention, a "branch-off pipe" 13 with a ventilator 14 is connected to the exhaust pipe 7, by which at least a part of the exhaust gasses, which otherwise would be emitted to the environment through channel 7, can be separated and brought into a compressed state by the exhaust gas compressor D and can be delivered to a distribution network (not shown) through a pipe line 15. The compressor D includes a low pressure stage 16 and a high pressure stage 17, in which the compressing and compressed exhaust gasses between the stages 16 and 17 and after the stage 17 respectively are passed through coolers 18 and 19, having water separators, repectively. Within the coolers 18 and 19, the temperature of the compressed exhaust gasses can be lowered to 70° C or less, when for example water for central heating is used as cooling medium. In this way, a part of the energy used for compressing the exhaust gasses, can be recovered.

Before the "separated" exhaust gasses are supplied to the compressor D, the seperated exhaust gasses are first pretreated in an auxiliary combustion device E to increase the CO_2-content. To that end, the exhaust gasses are used as combustion air in combustion device E, arranged for firing for example natural gas, which combustion device E is provided with heat exchanger bundles 20 and 21 in the shown embodiment. The amount of natural gas to be fired in the auxiliary combustion device can be regulated in such a way, that the remaining amount of O_2 in the exhaust gasses will be consumed almost totally. In this way, the CO_2-content, which is normally about 3,2 vol.%, can be almost tripled. Due to the increased CO_2-content the required amount of compression energy will be substantially lowered and accordingly the costs for distribution will be lowered.

The use of the relatively low-oxygen exhaust gasses from the steam generating device 5 as combustion air in the auxiliary combustion device E has a lowering effect on the NO_x-generation as a result, which is not only advantageous from an environmental-technical point of view, but also an advantageous effect on the use as fertilization gas.

The heat produced in the auxiliary combustion device E is used for the intermediate heating of the steam in the main steam turbine B by passing the steam from the high pressure part 8 through the heat exchanger bundle 21 in the auxiliary combustion device E before supplying it to the low pressure part 9. The power of the steam turbine B will be herewith increased accordingly. An other portion of the heat produced in the auxiliary combustion device E is used to produce additional steam, which is used to feed an auxiliary turbine 22 by which the compressor D is driven. The condensation water of the condenser 10, to which the output of the auxiliary steam turbine 22 is connected, is therefore passed through the heat exchanger bundles 20, which bundles are connected to the steam inlet pipe 23 and 24, to the high pressure part 8 of the main steam turbine and the auxiliary turbine 22 respectively.

Claims

1. A method for producing a gas containing CO_2, in particular for CO_2-fertilization in the greenhouse horticulture, characterized in that at least a part of the exhaust gasses produced by an installation for central electricity supply is seperated and entered into a distribution system in compressed and cooled state.

2. A method according to claim 1, characterized in that, prior to the compression, the CO_2-content of the seperated exhaust gasses is enriched by applying these exhaust gasses to an auxiliary combustion device as combustion gas, the exhaust gasses of which are supplied to a compressor.

3. A method according to claims 1-2, characterized in that the seperated exhaust gasses are compressed up to a pressure of approximately 12 bar.

4. A method according to claims 1-3, characterized in that at least a portion of the heat produced by the auxiliary combustion device is used for producing steam, which steam is used as a power source for the compressor.

5. Electricity production plant, comprising a combination of a gas turbine installation provided with a steam generating device, having an exhaust pipe for exhaust gasses, a steam turbine with a condenser and an electric generator, which steam turbine is fed with steam from the steam generating device, characterized in that a channel is branched-off the exhaust pipe of the steam generating device and is connected to a compressor, the output of which is connectable to a distribu-

tion network.

6. Plant according to claim 5, characterized in that an auxiliary combustion device is accommodated in the branched-off channel to the compressor, whereby the air inlet of the auxiliary combustion device is connected to the exhaust pipe of the steam generating device and the output of exhaust gasses of the auxiliary combustion device is connected to the input of the compressor.

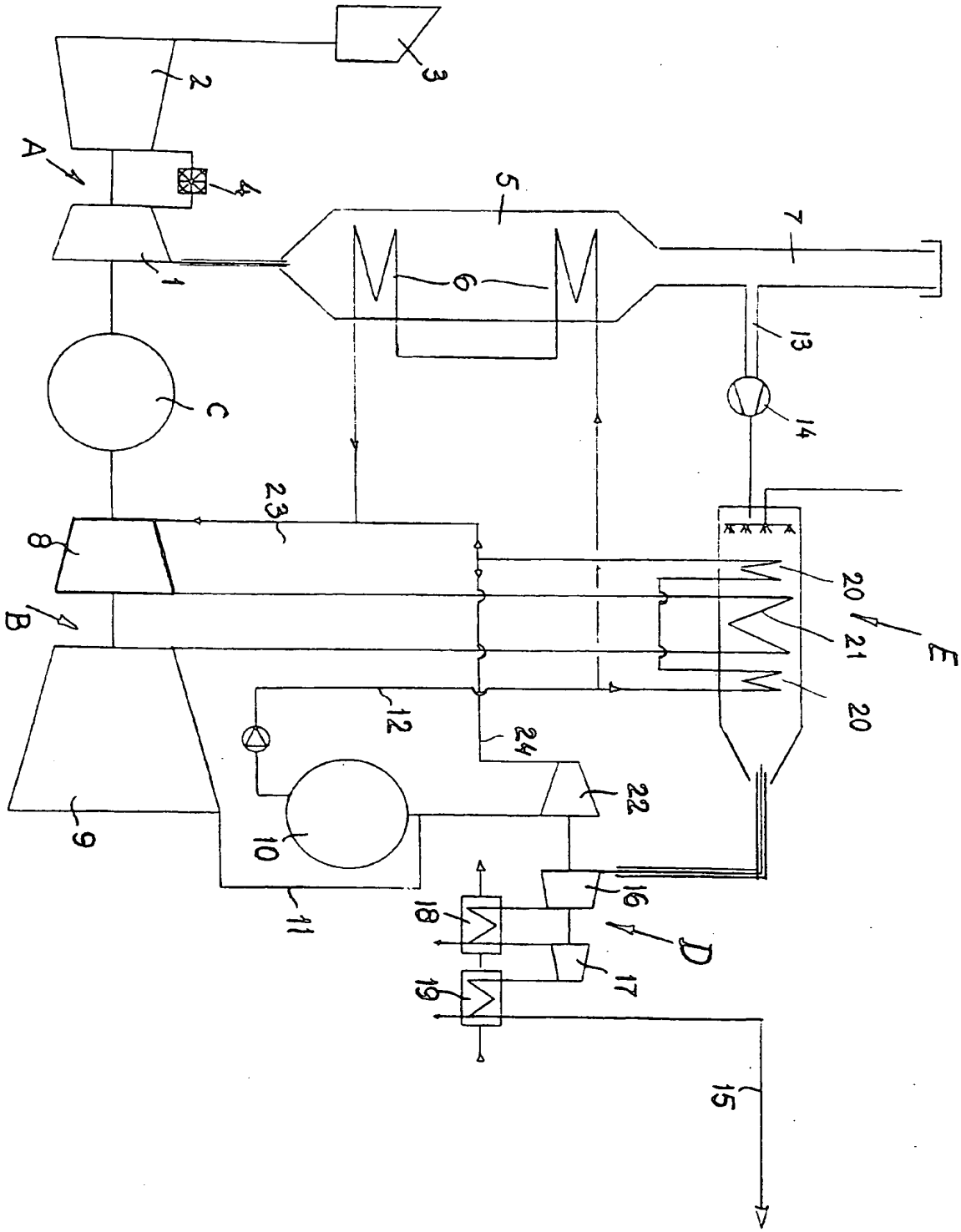
7. Plant according to claim 6, characterized in that the auxiliary combustion device has one or more heat exchanger bundles, which are accommodated in the steam circuit of the steam turbine as an intermediate heating stage.

8. Plant according to claims 6-7, chatacterized in that the auxiliary combustion device comprises one or more heat exchanger bundles, which form a part of the steam condensation water circuit of an auxiliary steam turbine driving the compressor.

9. Plant according to claim 8, characterized in that the output of the steam turbine and the output of the auxiliary steam turbine are connected to a common condenser.

10. Plant according to claims 5-9, characterized in that the compressor is a multistage compressor, whereby in the exhaust gas connection between the stages and in the output of the last stage a heat exchanger, fed with a cooling medium, a accommodated.

FIG. 1



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EUROPEAN SEARCH REPORT

Application Number
EP 92 20 3679.3

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	NL-A-8 302 861 (GRASSO'S KONINKLIJKE MACHINEFABRIEKEN)		B01D53/34 C01B31/18 A01G7/02 A01G9/18
A	DE-A-3 937 012 (VEB INGENIEURBETRIEB DER ENERGIEVERSORGUNG)		
A	US-A-4 073 089 (E.A. MAGINNES)		
A	DE-A-3 415 970 (WALTER FABINSKI)		
A	DE-A-3 915 060 (REINHOLD MANIURA)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B01D
C01B
A01G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	01 JULY 1993	BOGAERTS M.L.M.

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P0401)